BELL WORK
28-April-2015

What is the charge on each of the following atoms in C_2H_2?

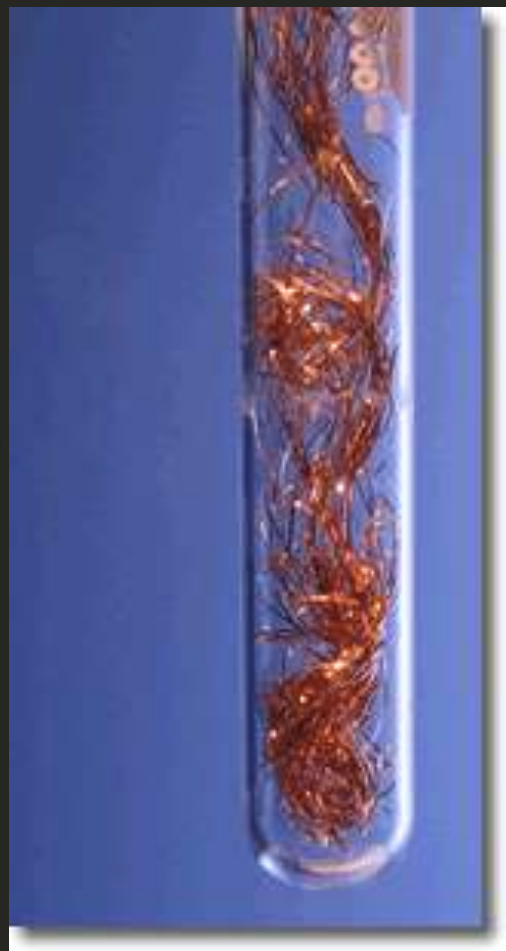
Agenda

What's a redox reaction

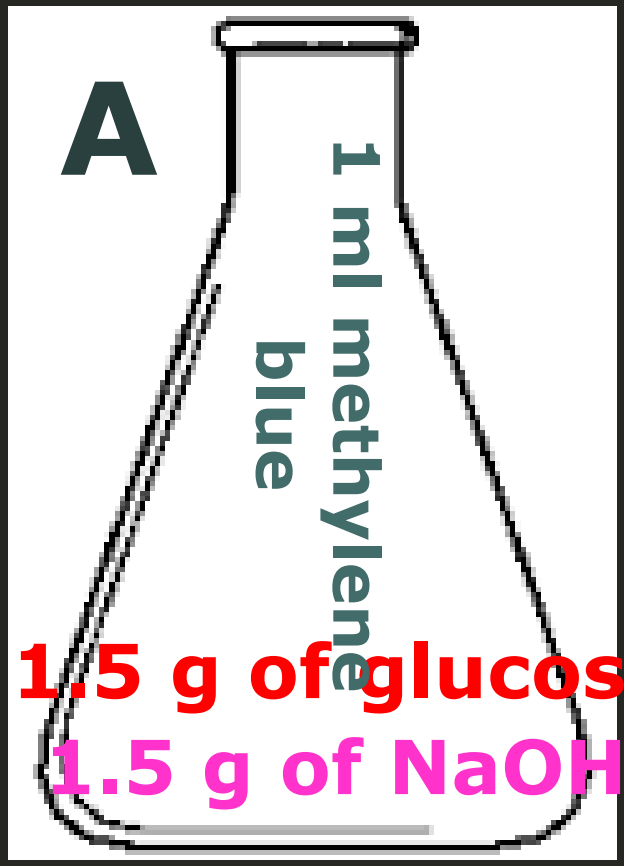
☺…

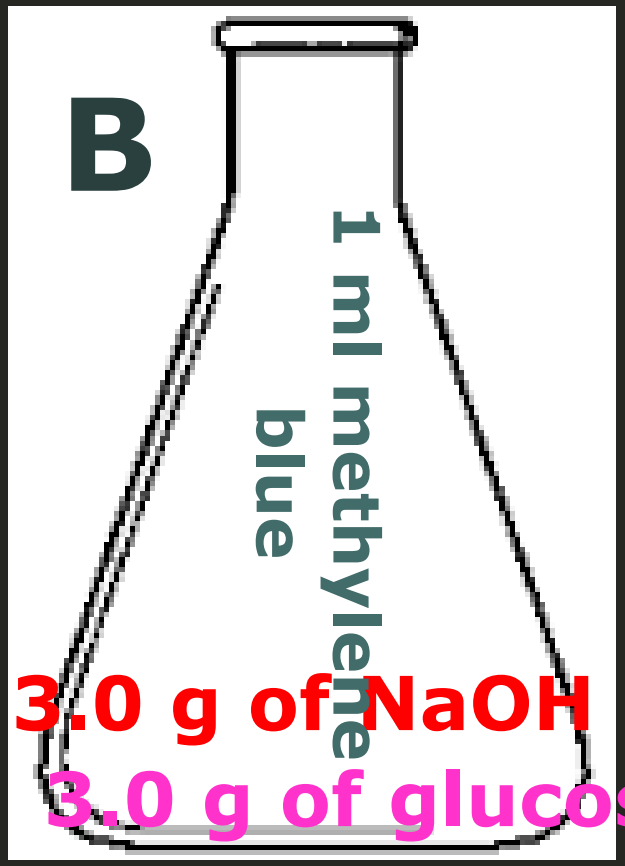
Objective

You will know what a redox reaction is and understand why the inspection method of balancing does not work.



Color Change Oxidation





$2CH_2OH–CHOH–CHOH–CHOH–CHOH–CHO + 1\ O_2 \rightarrow$
$2CH_2OH–CHOH–CHOH–CHOH–CHOH–COOH$

Redox Rxn

Redox rxns, or **oxidation reduction reactions**, have a number of similarities to acid-base rxns.

Fundamentally, redox rxns are a family of rxns that are concerned with the transfer of electrons between species.

You Think You Know Your Stuff

Try to balance this one by inspection:

4 Al (s) + **3** O_2 (g) → **2** Al_2O_3 (s)

There is also another method… called the Half Reaction method **BUT HOLD ON WE'RE** not there yet

Oxidation Number

The charge that atom would have if the compound was composed of ions

The oxidation # of an atom is zero in a elemental substance:

Na, Cu, Ag, Fe etc.

and zero in the seven diatomic elements:

H_2, N_2, O_2, F_2 ,Cl_2, Br_2, I_2

Oxidation Number

The oxidation number of simple ions is equal to the charge on the ion.

Na^+ ion is … **+1**

The sum of the oxidation numbers in a neutral compound is zero.

2(+1) + -2 = 0

H_2O

Oxidation Number

The sum of the oxidation numbers in a polyatomic ion is equal to the charge on the ion.

$$+6 + 4(-2) = -2$$

$$SO_4$$

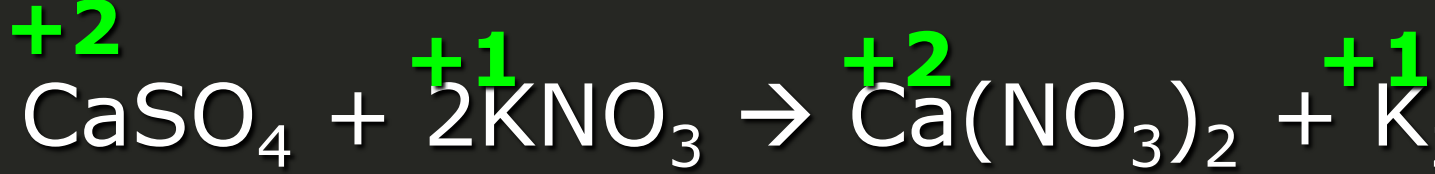
Try these…

Give me the oxidation number of the all the following atoms in the compounds:

Al_2O_3 **XeF_4** **$K_2Cr_2O_7$**

In a Reaction

What are the oxidation numbers of the cations in each of the elements in the rxn below?



What is Reduction?

The decrease in oxidation state (<u>gain</u> of electrons):

What is Oxidation?

The increase in oxidation state (<u>loss</u> of electrons):

$$\overset{-1}{NaCl} \rightarrow Na + \overset{0}{Cl_2}$$

Recall From Reading

Which of the following is a redox reaction?

A. $CuSO_4 + 2NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$

B. $3CuS + 8HNO_3 \rightarrow 3\ CuSO_4 + 8NO(g) + 4H_2O$

Identify what is being reduced

Guide for Writing & Balancing Half-Rxn Equations

1. Identify the key elements that undergo oxidation state change.

2. Split into two half rxn's

3. Balance the number of atoms of the key element on both sides of both half rxns.

Balancing Half-Rxn Equations

3.

a. Balance elements other than H and O

b. Balance O by adding H_2O

c. Balance H by adding H^+

d. Balance charge by adding e^-

Practice From Reading

Identify the oxidized and reduced elements then split into half rxns DO NOT BALANCE unless you think you have the stuff!

$$3Cu_{(s)} + 8HNO_{3(aq)} \rightarrow$$

$$3Cu(NO_3)_{2(aq)} + 4H_2O_{(l)} + 2NO_{(g)}$$

- http://www.wisc-online.com/Objects/ViewObject.aspx?ID=GCH7804

http://www.sciencegeek.net/APchemistry/APtaters/Redox/

"Step By Step"

Bell Work
30-April-15

What are the oxidation numbers of each atom and what is being reduced and oxidized?

$$Zn + HCl \rightarrow H_2 + ZnCl_2$$

Agenda

Half rxn method

Objective

You will know how to split up into half rxn

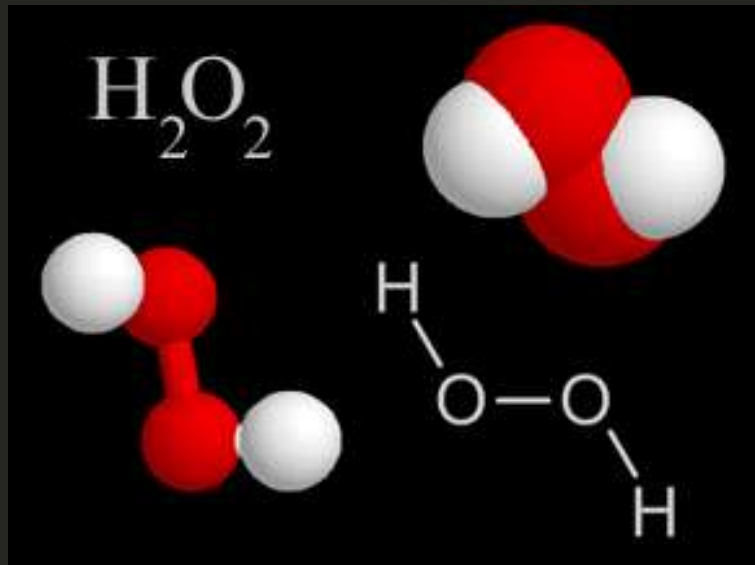
Try This

Balance the two half reactions for the rxn in an acid solution:

$$H_2O_2 + I^- \rightarrow I_2 + H_2O$$

1. Identify the key elements that undergo oxidation state change.

I: -1 → 0 **O: -1 → -2**



Try This

Balance the two half rxns for the rxn in an acid solution: $H_2O_2 + I^- \rightarrow I_2 + H_2O$

2. Split into two half rxn's

$H_2O_2 \rightarrow H_2O$

$I^- \rightarrow I_2$

Try This

Balance the two half rxns for the rxn in an acid solution: $H_2O_2 + I^- \rightarrow I_2 + H_2O$

3a. Balance the number of atoms of the key element on both sides of both half rxns.

$H_2O_2 \rightarrow 2\ H_2O$

$2I^- \rightarrow I_2$

Try This

Balance the two half rxns for the rxn in an acid solution: $H_2O_2 + I^- \rightarrow I_2 + H_2O$

3b and c. Add H_2O to balance O, then H^+ (in acid medium) to balance H, or OH^- (in basic medium), to balance the the half-rxns.

$$2H^+ + H_2O_2 \rightarrow 2H_2O$$

$$2I^- \rightarrow I_2$$

Try This

Balance the two half rxns for the rxn in an acid solution: $H_2O_2 + I^- \rightarrow I_2 + H_2O$

3d. Add electrons to compensate for the changes of oxidation state

$$2e^- + 2H^+ + H_2O_2 \rightarrow 2H_2O$$

$$2I^- \rightarrow I_2 + 2e^-$$

Try This

Balance the two half rxns for the rxn in an acid solution:

$$H_2O_2 + I^- \rightarrow I_2 + H_2O$$

These are your balanced half rxns

$$2H^+ + H_2O_2 + 2e^- \rightarrow 2H_2O$$

$$2I^- \rightarrow I_2 + 2e^-$$

Try these on your own

$ClO_2 \rightarrow ClO_2^- + ClO_3^-$

$ClO_2 + e^- \rightarrow ClO_2^-$

$H_2O + ClO_2 + \rightarrow ClO_3^- + e- + 2H^+$

Go-

$Cl_2\,(g) + S_2O_3^{2-}(aq) \rightarrow Cl^-(aq) + SO_4^{2-}$

What is being reduced?

What is being oxidized?

Some Practice

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problem 4-17

Split up the rxns into half rxns and balance half-rxn

☺

Bell Work
1-May-15

$H_2O_2 \rightarrow 2H^+ + O_2 + ?e^-$

Note that H_2O_2 is being oxidized in this rxn.

How many electrons should there be in the half rxns ☺

Agenda

Complete Half reaction method

Objective:

You will know how to solve redox reactions using the half reaction method steps 1-6

Warm Up

$Na + Br_2 \rightarrow NaBr$

$Zn + S \rightarrow ZnS$

Hint:

X + Y → XY

X → X^+

Y → Y^-

Half Rxn Practice

1. $S^{-2} + I_2 \rightarrow I^{-1} + S$

2. $SnCl_2 + HgCl_2 \rightarrow SnCl_4 + HgCl$

3. $HNO_3 + H_2S \rightarrow NO + S + H_2O$

4. $NaClO + H_2S \rightarrow NaCl + H_2SO_4$

Half Rxn Practice

5. $I_2 + HNO_3 \rightarrow HIO_3 + NO_2 + H_2O$

6. $MnO_4^{-1} + H^+ + Cl^{-1} \rightarrow Mn^{2+} + Cl_2 + H_2O$

7. $Ag + Cr_2O_7^{2-} + H^+ \rightarrow Ag^+ + Cr^{3+} + H_2O$

Step 6 for Balancing a Redox Rxn

1. **Identify the elements that are oxidized and reduced by examining their Oxidation state**

2-3. **Write the oxidation and reduction half-rxns and balance half rxns.**

Step 6 for Balancing a Redox Rxn

4. Add the two half-rxns algebraically such that the electrons in the two half-rxn equations cancel completely. Cancel other species such as H^+, OH^-, and H_2O common to the two sides, if necessary.
5. Check your equation and make certain that numbers of atoms and charge are equal on both sides.

Lets Try One

Balance the following equation:

$Cr_2O_7^{2-} + H_2C_2O_4 \rightarrow Cr^{3+} + CO_2 + H_2O$

1. Identify the elements that are oxidized and reduced by examining their Oxidation state

$Cr_2O_7^{2-} + H_2C_2O_4 \rightarrow Cr^{3+} + CO_2 + H_2O$

+6 +3 +3 +4

Reduced: Cr **Oxidation: C**

Lets Try One

Balance the following equation:

$Cr_2O_7^{2-} + H_2C_2O_4 \rightarrow Cr^{3+} + CO_2 + H_2O$

3a-3b. Write the oxidation and reduction half-rxns and balance half rxns.

$Cr_2O_7^{2-} + 14H^+ + 6\ e^- \rightarrow 2Cr^{3+} + 7H_2O$

$H_2C_2O_4 \rightarrow 2\ CO_2 + 2H^+ + 2\ e^-$

Lets Try One

Balance the following equation:

$$Cr_2O_7^{2-} + H_2C_2O_4 \rightarrow Cr^{3+} + CO_2 + H_2O$$

4. Add the two half-rxns algebraically such that the e^- in the two half-rxn equations cancel completely. Cancel other species such as H^+, OH^-, and H_2O common to the two sides, if necessary.

$$Cr_2O_7^{2-} + 14\ H^+ + 6\ e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$3(\ H_2C_2O_4 \rightarrow 2\ CO_2 + 2\ H^+ + 2\ e^-\ )$$

$$3H_2C_2O_4 \rightarrow 6\ CO_2 + 6\ H^+ + 6\ e^-$$

Lets Try One

Balance the following equation:

$$Cr_2O_7^{2-} + H_2C_2O_4 \rightarrow Cr^{3+} + CO_2 + H_2O$$

3. Add the two half-rxns algebraically such that the electrons in the two half-rxn equations cancel completely. Cancel other species such as H^+, OH^-, and H_2O common to the two sides, if necessary.

$8H^+$

$$Cr_2O_7^{2-} + 14\,H^+ + 6\,e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$+ \quad 3H_2C_2O_4 \rightarrow 6\,CO_2 + 6\,H^+ + 6\,e^-$$

$$Cr_2O_7^{2-} + 8H^+ + 3H_2C_2O_4 \rightarrow 2Cr^{3+} + 7H_2O + 6CO_2$$

Lets Try Another

Balance the equation from the two half-rxns:

$Cd \rightarrow Cd^{2+} + 2\ e^-$

$4H^+ + NO_3^- + 3e^- \rightarrow NO + 2\ H_2O$

Lets Try Another

Balance the equation from the two half-rxns:

$3(Cd \rightarrow Cd^{2+} + 2e^-)$

$2(4H^+ + NO_3^- + 3e^- \rightarrow NO + 2H_2O)$

$3Cd \rightarrow 3Cd^{2+} + 6e^-$

$8H^+ + 2NO_3^- + 6e^- \rightarrow 2NO + 4H_2O$

$3Cd + 8H^+ + 2NO_3^- \rightarrow 3Cd^{2+} + 2NO + 4H_2O$

Half Rxn Practice

1. $S^{-2} + I_2 \rightarrow I^{-1} + S$

2. $Sn^{2+} + Hg^{2+} \rightarrow Sn^{4+} + Hg^{1+}$

3. $HNO_3 + H_2S \rightarrow NO + S + H_2O$

4. $NaClO + H_2S \rightarrow NaCl + H_2SO_4$

Bell Work
4-May-2015

At what temperature (°C) would 2.10 moles of N_2 gas have a pressure of 1.25 atm and in a 25.0 L tank?

Agenda

Half rxn method in basic solution

DEMOs??

Objective:

You will know how to solve redox reactions in basic solutions using the half reaction method.

Redox in Basic solutions

Balance as if the reaction is in an acidic solution.

Use OH^- ions to neutralize H^+.

Redox in Basic Solutions Practice

$Cr(OH)_{3(s)} + ClO_3^-{}_{(aq)} \rightarrow CrO_4^{2-}{}_{(aq)} + Cl^-{}_{(aq)}$

$2Cr(OH)_{3(s)} + ClO_3^-{}_{(aq)}$

$\rightarrow 2CrO_4^{2-}{}_{(aq)} + Cl^-{}_{(aq)} + H_2O_{(l)} + 4H^+{}_{(aq)}$

Because there are 4 H^+ on the right side of our equation above, we add 4 OH^- to each side of the equation.

Redox in Basic Solutions Practice

$2Cr(OH)_3 + ClO_3^- + 4OH^-$

$\rightarrow 2CrO_4^{2-} + Cl^- + H_2O + 4H^+ + 4OH^-$

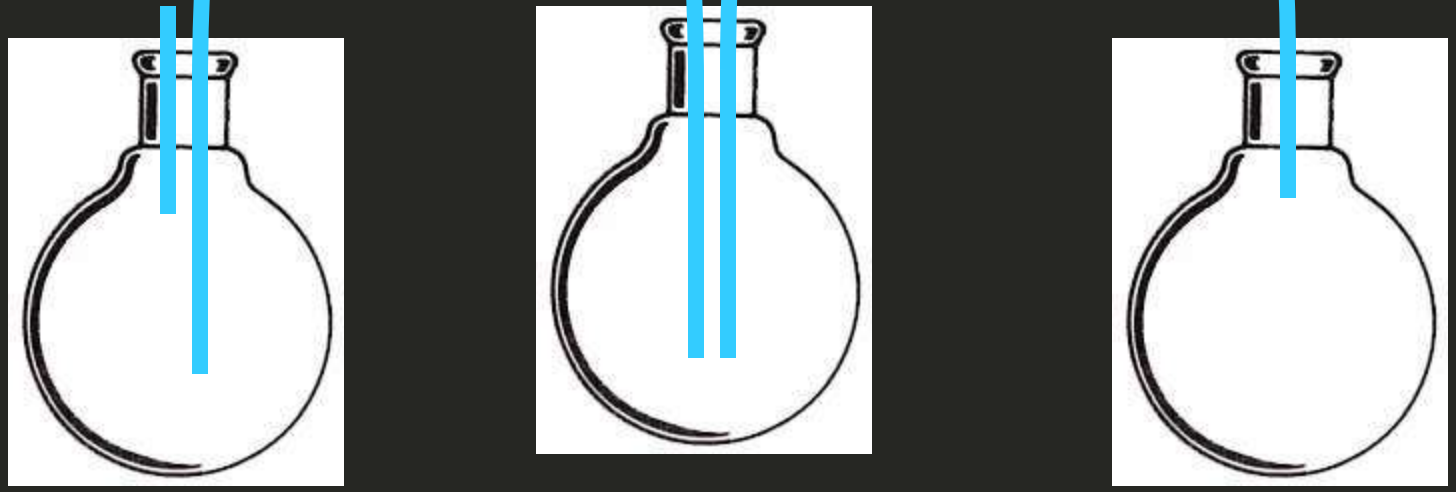
Because there are 4 H^+ on the right side of our equation above, we add 4 OH^- to each side of the equation.

$2Cr(OH)_3 + ClO_3^- + 4OH^-$

$\rightarrow 2CrO_4^{2-} + Cl^- + H_2O + 4H_2O$

$2Cr(OH)_3 + ClO_3^- + 4OH^- \rightarrow 2CrO_4^{2-} + Cl^- + 5H_2O$

Penny Fountain



70ml of
0.1M NaOH

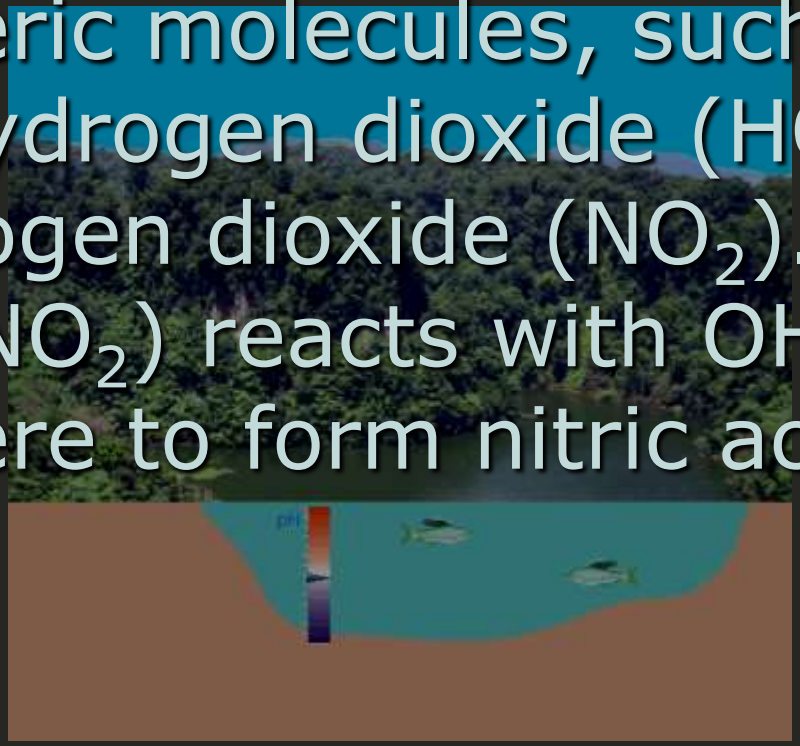
150ml of 0.1M
HNO_3 +
Phenophtalien

10ml of
16M HNO_3

What is the acid base reaction here?

Penny Fountain Redox Reaction

Nitric oxide (NO) is oxidized by atmospheric molecules, such as ozone (O_3) or hydrogen dioxide (HO_2), to form nitrogen dioxide (NO_2). Nitrogen dioxide (NO_2) reacts with OH in the atmosphere to form nitric acid (HNO_3).



Penny Fountain Redox Reaction

$Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO_2$

Balance as:

$Cu + NO_3^- \rightarrow Cu^{2+} + NO_2$

Penny Fountain Gas Law Rxn

$Cu(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + NO_2(g)$

Given the balanced equation above, what volume of gas is produced at 23°C and 0.9atm, if a _____g penney is used?

Bell Work
5-May-2015

How would you prepare 100mL of a 3.0M NaOH solution given the following material? Be specific (give masses)!

X.Xg scale

Scoopula

DI Water

Weigh paper

100mL volumetric flask

Objective

To explore Redox reaction and metal ion exchanges in the lab

Bell Work
5-May

Staple and turn in the following:

1. BW through 1-May-2015

2. Redox Tutorial #1-14

Gold Penny Lab

Caution 3.0M NaOH is caustic

The cleaner your penny is the more likely it will "bronze"

Note: *2. Obtain at least ~~3~~ 1 pennies per student.*

11. Move penny in and out of flame, or it will melt!